

WHAT IS CLAIMED IS:

1. An optical transmission module which sends and receives light transmitted bi-directionally through an optical fiber, said optical transmission module comprising:

5 a light source which radiates light of a first wavelength;

a light-receiving section which receives light of a second wavelength emitted from said optical fiber; and

10 a binary-type diffractive optical element with a staircase-shaped diffractive surface, which has principal diffractive action of different diffraction orders respectively for the light of said first wavelength and the light of said second wavelength, wherein

15 said diffractive optical element separates the first optical axis passing from said light source to said optical fiber and the second optical axis passing from said light-receiving section to said optical fiber.

2. The optical transmission module according to claim 1, wherein said diffractive optical element bends one
20 of the light of said first wavelength and the light of said second wavelength by a diffraction action and does not bend the other light by performing diffraction action of order 0.

3. The optical transmission module according to claim 1, wherein said diffractive optical element diffracts
25 the light of said first wavelength and the light of said

second wavelength with diffraction orders of mutually opposite signs, so that the light of said first wavelength and the light of said second wavelength are bent toward mutually opposite directions.

5 4. The optical transmission module according to claim 1, wherein said diffractive optical element has lens action which converges the light of first wavelength from said light source onto said optical fiber, or alternatively
10 has lens action which converges the light of said second wavelength from said optical fiber onto said light-receiving section, and the center of the lens is made eccentric from a straight line passing from said light source to said optical fiber or alternatively from a
15 straight line passing from said optical fiber to said light-receiving section.

 5. The optical transmission module according to claim 1, further comprising a lens which converges and bends light from said light source toward said optical fiber and converges and bends light from said optical fiber
20 toward said light-receiving section, wherein

 said diffractive optical element has a grating shape uniform in one direction on an incidence surface which receives light from said light source.

 6. The optical transmission module according to
25 claim 1, wherein said diffractive optical element is a

transmission-type diffractive optical element.

7. The optical transmission module according to claim 1, wherein said diffractive optical element is a reflection-type diffractive optical element.

5 8. The optical transmission module according to claim 2, wherein one of said first wavelength and said second wavelength is a wavelength of a 1.3 μ m band while the other is a wavelength of a 1.55 μ m band, the number of steps in the staircase of said diffractive optical element being
10 equal to or greater than 5 and equal to or less than 8.

9. The optical transmission module according to claim 3, wherein one of said first wavelength and said second wavelength is a wavelength of a 1.3 μ m band while the other is a wavelength of a 1.55 μ m band, the number of steps
15 in the staircase of said diffractive optical element being 8.

10. The optical transmission module according to claim 4, wherein said diffractive optical element comprises a first diffractive optical element and a second
20 diffractive optical element, said first diffractive optical element having lens action that converges the light of said first wavelength from said light source onto said optical fiber and having transmission action for the light of said second wavelength from said optical fiber, and said second
25 diffractive element having lens action that converges the

light of said second wavelength from said optical fiber onto said light-receiving section and having transmission action for the light of said first wavelength from said light source.

5 11. The optical transmission module according to claim 4, further comprising a lens which converges and bends light from said light source toward said optical fiber and converges and bends light from said optical fiber toward said light-receiving section, wherein said
10 diffractive optical element has lens action that converges and bends the light of said first wavelength from said light source onto said optical fiber and has transmission action for the light of said second wavelength from said optical fiber, or alternatively

15 said diffractive element has lens action that converges the light of said second wavelength from said optical fiber onto said light-receiving section and has transmission action for the light of first wavelength from said light source.

20 12. The optical transmission module according to claim 10, wherein said first diffractive optical element and said second diffractive element are respectively formed on two surfaces of a single member facing to each other in opposite directions.

25 13. The optical transmission module according to

claim 6, wherein said transmission-type optical element is positioned so as to be inclined from an axis perpendicular to the axis connecting said light source and said light-receiving section, on a plane on which said light source and said light-receiving section are disposed.

14. The optical transmission module according to claim 5, wherein said diffractive optical element is formed on a surface of said lens.

15. The optical transmission module according to claim 11, wherein said diffractive optical element has eccentric non-spherical action as said lens action.

16. The optical transmission module according to claim 1, wherein said light source and said light-receiving section are arranged on a single substrate, said substrate and said diffractive optical element being housed in a sealed single package.

17. The optical transmission module according to claim 16, wherein an electric signal sent to said light source and a received electric signal from said light-receiving section cancel to each other out, so that mutual electric cross talk is eliminated.

18. The optical transmission module according to claim 10, wherein one of said first wavelength and said second wavelength is a wavelength of a $1.3\mu\text{m}$ band while the other is a wavelength of a $1.55\mu\text{m}$ band, the number of steps

in the staircase of said first diffractive optical element being 5 or 6, and the number of steps in the staircase of said second diffractive optical element being 7.